TX-O COMPUTER MASSACHUSETTS INSTITUTE OF TECHNOLOGY CAMBRIDGE 39, MASSACHUSETTS

M-5001-29

THE FUTURE TE-O INSTRUCTION CODE

I. ARDEIWIATIONS

AG : ACousticator

la : Livo Esaister

FO : Progrem Counter

Mik : Memory Buffer Register

PER: PhotoMestric Topo Bester

TAC : Zogglo Switch Accumilator

TER: Toggle Sultch Buffer Register

LP: : Light Pon FF

C(AC): "Contents of AC"

"Raplaces"

X : Complement of X:

A : Intersect; and; logical product.

U : Union; inclusive or; logical cum.

A : Partial add; inequivalence; exclusive or,

mod n: Modulo n ; y = x mod n meens x = kn + y for some integer k, 0 < k \le n - l.

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III. OPERATE CLASS COMMANDS

(C) MICHO-ORDERS

| MNEMONIC | ACTION | SYMBOLIC DESCRIPTION |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| CLA | CLear AC | O→C(AC) |
| AM B | transfer AC contents to MBR | C(AC)->C(M BR) |
| .2M.B | transfer AR contents to MBR | C(XR) bits 5-17->C(MBR) bits 5-17. C(XR) bit 0->C(MBR) bits 0-4. |
| m Bi. | transfer MBR contents to LR | C(NBR)->C(IR) |
| JM B | transfer LR contents to MBR. Note: IMB & MIR, if used simul- taneously, interchange C(IR) and C(MBR). | $C(XR)_{5-17} \rightarrow C(MBR)_{5-17}$ $C(XR)_{4} \rightarrow C(MBR)_{0-4}$ |
| MEX | transfer MBR contents to XR | $\frac{C(MBR)_{5-17} \longrightarrow C(XR)}{E(MBR)_{0} \longrightarrow C(XR)_{4}}$ |
| CYR | CYcle AC contents Right one binary position. (AC bit 17 goes to AC bit 0) | $C(AC)_1 \rightarrow C(AC)_j$ $i = 0, 1, \dots, 17$ $j = (i+1) \mod 18$ |
| SHR | shift AC contents right one binary position (AC bit 0 is unchanged, bit 17 is lost) | $C(AC)_{i} \rightarrow C(AC)_{i} + 1,$ i = 0, 1, 2, 16 |
| Anb | ANd (logical product) LR contents into MBR. | C(IR) MC(MBR)->C(MBR) |
| ORB | OR (logical sum) IR contents into MBR. | C(IR)UC(MRR) and $C(MRR)$ |
| COM | COmplement AC | C(AC) |
| PAD | Partial ADd MBE to AC (for each MBE one, complement the corresponding AC bit.) | $G(NBR) \wedge G(AG) \rightarrow (AG)$ |
| CRY | A CarRY digit is a ONE if in the next least significant digit, either AC = 0 and MBR = 1, or AC = 1 and carry digit = 1. The carry digits so determined are partial added to the AC by CRY. PAD and CRY used together give a full one's complement addition of C(MBR) to C(AC). | |

III. OPERATE CLASS COMMANDS

(D) IN-OUT GROUP COMMANDS WHICH CAN BE USED WITH MICRO-ORDERS SPECIFIED BY BITS 9-17.

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| OCTAL CODE | MNIMONIC | ACTION | CYCLE AND TIME PULSE |
| 631000 | CIT | Clear Left 9 bits of AC | 0.6 |
| 632000 | CIR | Clear Right 9 bits of AC | 0.6 |
| 607000 | SPF | Set Program Flag contents from MER | 2.6 |
| 606000 | RPF | Reed Progrem Flag contents into MBR. (inclusive or) | 1.2 |
| 602000 | TBR | transfer TBE contents to MBR. (inclusive or) | 1.2 |
| 601000 | Tac | transfer TAC ones to AC (inclusive or) | and a state of the same of the |
| 603000 | PES | set AC bit O from light PEN FF. and AC bit I from light gun FF. (FF's contain one if pen or gun saw displayed point). Then clear both light pen and light gun FF's. | I o I. |
| 620000 | CPY | CoPY synchronizes transmission of information between in-out equipment and computer | 妆妆 |
| 621000 | R1L | Read ONE Line of tape from PETR into AC bits 0, 3, 6, 9, 12, 15 with CYR before read | IOS |
| 623000 | R3L | Read THREE Lines of tape from PETR into AC bits 0. 3. 6. 9. 12. 15. with CYR before each read | 108 |
| 622000 | pis | DISplay a point on scope (AC bits 0-8 specify X coordinate, AC bits 9-17 specify Y coordinate) NOTE: Scope coordinate (0,0) is at center of scope | 108 |
| 626000 | Р6Н | Punch one SIX-bit line of Flexo tape (without seventh hole) from AC bit 2, 5. 8, 11, 14, 17. NOTE: Lines with- out seventh hole are ignored by PEFR | 108 |

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| CTAL CODE | Min yan om i c | ACTION | time pulse |
| 627000 | P7H | same as P6H, but with SEVENTH hole | IOS |
| 625000 | TYP | read one character from on-line TYPewriter into LR bits 12 to 17. | IOS |
| 610000 through 617000 | EXO through EX7 | operate user's EMJernal equipment | TOS |
| 600000 | NOS. | perform No in-out group OPeration | and the major well-art of a discussion there is necessarily to the transfer of the major and the second of the sec |
| 630000 | Andread of the state of the sta | Ball the computer (chime sound). | 1. 8 |

IV. OPERATE CLASS INSTRUCTIONS

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| MHEMONIC | COTAL VALUE | OPERATION |
| opr | 600000 | No operation. |
| cll | 631000 | Clear left half of accumulator to zero. |
| clr | 632000 | Clear right half of accumulator. |
| cla | 700000 | Clear entire accumulator to +0. |
| clc | 700040 | Clear and complement: set accumulator to -0. |
| lro | 600200 | Clear live register to +0. |
| Mro | 600001 | Clear index register to +0. |
| cal | 700200 | Clear accumulator and live register to +0. |
| cax | 700201 | Clear accumulator and index register to +0. |
| alr | 640200 | Place accumulator in live register. |
| alo | 640220 | AIR, then set AC to +O. |
| alc | 640260 | ALR, then set AC to -O. |
| arr | 640001 | Place accumulator in index register. |
| axo | 640021 | AXR, then set AC to +0. |
| axc | 640061 | AXR, then set AC to -0. |
| zl r | 600300 | Place index register in live register. |
| lec | 700022 | Place live register in accumulator. |
| lce | 700062 | Place complement of live register in accumulator. |
| xac | 700120 | Place index register in accumulator. |
| xcc | 700160 | Place complement of index register in accumulator. |
| caj | 640030 | Cycle accumulator left one place. |
| cyr | 600600 | Cycle accumulator right one place. |
| shr | 600400 | Shift accumulator right one place, bit 0 remains unchanged. |
| lel | 700012 | Place live register in accumulator cycled left once. |
| lar | 700622 | Place live register in accumulator cycled right once. |
| rel. | 700110 | Place index register in accumulator cycled left once. |
| all | 640230 | Place accumulator in live register, then cycle AC left once. |
| alx | 640031 | Flace accumulator in index register, then cycle AC left once. |
| ial . | 740222 | Interchange accumulator and live register. |
| izl | 600303 | Interchange index register and live register. |
| led | 600032 | Add live register to accumulator. |

| MNIM ONIC | OCTAL VALUE | OPERATION |
|-----------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| zed | 600130 | Add index register to accumulator. |
| iad | 640232 | Interchange and add: accumulator is placed in the live register and the previous contents of the live register are added to it. |
| anl | 640207 | Logical and of AC and LR is placed in IR. |
| ano | 740207 | AML, then clear AC. |
| ana | 740027 | Logical and of AC and IR is placed in AC. |
| orl | 640205 | Logical or of AC and IR is placed in IR. |
| oro | 740205 | ORL, then clear AC. |
| ora | 740025 | Logical or of AC and La is placed in AC. |
| TIR | 700322 | Place IR in AC, then place XR in LR. |
| Tar | 640203 | Place IE in XE, then place AC in IE. |
| lcd | 600072 | Contents of LR minus those of AC are placed in AC. |
| xcd | 600170 | Contents of IR minus those of AC are placed in AC. |
| com | 600040 | Complement the accumulator. |
| lpd | 600022 | Logical <u>exclusive or</u> of AC and LR is placed in AC. (partial add) |
| ory | 600012 | Carry. Result of this operation is same as if contents of LR were added to <u>exclusive or</u> of AC and LR. Partial add and carry result in a full add. |
| tac | 601000 | Contents of test accumulator are or ad to those of AC. |
| tbr | 602000 | Contents of test buffer register are or ed to those of the memory buffer register. |
| pen | 603000 | Contents of pen flip-flops 1 and 2 replace contents of AC bits 0 and 1. Pen flip-flops are cleared. |
| rpf | 706020 | The program flag register is placed in the accu- mulator. |
| cpf | 607000 | The program flags are cleared. |
| cpy | 620000 | Transmits information between the live register and selected input-output unit. |
| rle | 721000 | Read one line paper tape into accumulator bits 0, 3, etc. |
| r3e | 723000 | Read three lines of paper tape. |
| dis | 622000 | Display point on CRT corresponding to contents of AC. |

| MNIMONIC | OCTAL VALUE | OPERATI ON |
|----------|-------------|----------------------------------------------------------------------------------------|
| dso | 662020 | DIS, then clear accumulator. |
| prt | 624000 | Print one on-line floxo character from bits 2, 5. etc. of AC |
| pnt | 624600 | PRT, then cycle AC right once to set up another character. |
| pno | 664020 | FRT then clear accumulator. |
| p6h | 626000 | Punch one line of paper tape 6 holes from bits 2, 5, etc. of AC then cycle right once. |
| p7h | 627600 | Same, but punch 7th hole. |
| рба | 726000 | Clear accumulator and punch a line of blank tape. |
| рбъ | 766020 | Punch a line of blank tape but save the accu- mulator. |
| hīt | 630000 | Stops computer |
| typ | 625000 | Read one character from on-line flexowriter into LR bits 12 through 17. |
| p60 | 666020 | p6h then clear AC. |
| p70 | 667020 | p7h then clear AC. |